4-Years Bachelor of Science/Arts (MATHEMATICS)

CBCS Syllabus

Semester-I

MJC-01: Algebra (06 credits) (Lecture: 60)

Course Objectives: The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, number theory and matrices to understand their linkage to the real-world problems.

Course Learning Outcomes: This course will enable the students to:
i) Employ De Moivre's theorem in a number of applications to solve numerical problems.
ii) Apply Euclid's algorithm and backwards substitution to find greatest common divisor.
iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.

Course Contents:

Unit 1 **(Lecture: 10)**
Polar representation of complex numbers, De -Moivre's theorem and its applications, Logarithms of complex quantities, Hyperbolic functions, Gregory series, Summation of series, Resolution into factors.

Unit 2 **(Lecture: 12)**
Cartesian product of sets, Equivalence relations, partition, partial and total order relation Functions, Composition of functions, Invertible functions, Cardinality of a set, Countable and Uncountable sets, Cantor's theorem,

Unit 3 **(Lecture: 12)**
Well-ordering property of positive integers, Division algorithm, Euclidean algorithm, Fundamental Theorem of Arithmetic, Modular arithmetic and basic properties of congruences, Principle of mathematical induction.

Unit 4 **(Lecture: 12)**
Matrices, Operation on Matrices, Kinds of matrices, Transpose, symmetric & skew symmetric Matrices, Hermitian, skew Hermitian Matrices, Adjoint and Inverse of a matrix, orthogonal matrix, Solution of a system of linear equations by matrix methods. Echelon forms, Rank of a matrix.

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Unit 5 **(Lecture: 14)**

Fundamental theorem of algebra, Relation between roots and coefficients of a polynomial equation, Symmetric Function of roots, Transformation of equation, Descartes rule of signs, Solution of Cubic equation (Cardon's method) and bi quadratic equation (Euler's method).

References:

1. Dickson, Leonard Eugene (1922). *First Course in The Theory of Equations*. John Wiley & Sons, Inc. New York.
2. Kolman, Bernard, & Hill, David R. (2001). *Introductory Linear Algebra with Applications* (7th ed.). Pearson Education, Delhi. First Indian Reprint 2003.

Additional Readings:

1. Andrilli, Stephen, & Hecker, David (2016). *Elementary Linear Algebra* (5th ed.). Academic Press, Elsevier India Private Limited.
2. Burton, David M. (2007). *Elementary Number Theory* (7th ed.). Tata Mc-Graw Hill Edition, Indian Reprint.
3. K.K.Jha , Advanced Set Theory.Nav BharatPrakashan Patna
4. M.L.Khanna, Theory of Equations, Jai Prakash Nath& Co. Merrut (U.P.)
5. Lalji Prasad, Matrices, Paramount Publications Patna
6. Dasgupta , Trigonometry, Bharti Bhawan Patna.

MIC-01: Algebra (03 credits) (Lecture: 30)

Course Objectives: The primary objective of this course is to introduce the basic tools of theory of equations, complex numbers, number theory and matrices to understand their linkage to the real-world problems.

Course Learning Outcomes: This course will enable the students to:
i) Employ De Moivre's theorem in a number of applications to solve numerical problems.
ii) Apply Euclid's algorithm and backwards substitution to find greatest common divisor.
iii) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.

Course Contents:

Unit 1 **(Lecture: 08)**
Polar representation of complex numbers, De Moivre's theorem and its applications, Logarithms of complex quantities'Hyperbolic functions,Gregory series , Summation of series,.

Unit 2 **(Lecture: 07)**
Cartesian product of sets, Equivalence relations, Functions, Composition of functions, Invertible functions, Partial and Total order relation,Countable and Uncountable sets,

Unit 3 **(Lecture: 08)**
Matrices, Operation on Matrices, Kinds of matrices, Transpose, symmetric & skew symmetric matrices, Hermitian and skew Hermitian matrices , Adjoint and Inverse of a matrix, Solution of a system of linear equations by matrix methods.

Unit 4 **(Lecture: 07)**
Fundamental theorem of algebra, Relation between roots and coefficients of a polynomial equation, Evaluation of symmetric functions of roots , Transformation of equation, Solution of Cubic equation (Cardon's method).

References:

1. Dickson, Leonard Eugene (1922). *First Course in The Theory of Equations*. John Wiley & Sons, Inc. New York.
2. Lay, David C., Lay, Steven R., & McDonald, Judi J. (2016). *Linear Algebra and its Applications* (5th ed.). Pearson Education

Additional Readings:

1. Andrilli, Stephen, & Hecker, David (2016). *Elementary Linear Algebra* (5th ed.). Academic Press, Elsevier India Private Limited.

2. Burton, David M. (2007). *Elementary Number Theory* (7th ed.). Tata Mc-Graw Hill Edition, Indian Reprint.
3. K.K.Jha , Advanced Set Theory, Nav Bharat Publication, Patna
4. M.L.Khanna, Theory of Equations, Jai Prakash Nath& Co. Merrut (U.P.)
5. Lalji Prasad, Matrices, Paramount Publications Patna
6. Dasgupta , Trigonometry, Bharti Bhawan Patna

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Semester-II

MJC-02: Calculus & Geometry (06 credits) (Lecture: 60)

Course Objectives: The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real-world problems.

Course Learning Outcomes: This course will enable the students to:
i) Apply derivatives in Optimization, Social sciences, Physics and Life sciences etc.
ii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.

Course Contents:

Unit 1 **(Lectures: 12)**
Successive differentiation and Leibnitz's theorem, Maclaurin 's and Taylor's series of Expansion, Tangent and Normal, Partial differentiation and Euler's theorem, Total Differential, L'Hospital's rule, , Curvature, Asymptotes, Curve tracing in Cartesian coordinates and polar coordinates of standard curves.

Unit 2 **(Lectures: 12)**
Integration of rational and irrational functions. Evaluation of definite integrals, Reduction formulae. Area, Length of plane curves and area bounded by plane curves. Volume and surface area of solid of revolution, Beta and Gamma Functions, Multiple Integrals.

Unit 3 **(Lectures: 10)**
Transformation of rectangular axes, General equations of conics and its reduction to the normal form, Equation of the tangent and normal at a point of the Conics.

Unit 4 **(Lectures: 12)**
Sphere, Cone, Cylinder, Central conicoid, Paraboloids, Plane section of conicoid, Generating lines, Tangent plane and normal to a conicoid.

Unit 5 **(Lectures: 14)**
Scalar triple product and vector triple product, Product of four vectors, Introduction to vector functions, Operations with vector-valued functions, Differentiation and integration of vector functions, Gradient of a scalar and Divergence and Curl of a vector function in Cartesian coordinate.

References:

1. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Indian Reprint (2016) by Wiley India Pvt. Ltd. Delhi.
2. Osborne, George. A. (1906). *Differential and Integral Calculus with Examples and Applications*. Revised Edition. D. C. Health & Co. Publishers. Boston, U.S.A.
3. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.

Additional Readings:

1. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). *Thomas' Calculus* (13th ed.). Pearson Education, Delhi. Indian Reprint 2017.
2. Lalji Prasad , Integral Calculus, Paramount Publications Patna
3. B.C. Das and B.N. Mukherjee, Differential calculus , Integral Calculus, Dhur & Sons Pvt.Ltd. Kolkatta
4. Shanti Narayan , P.K.Mittal , Integral Calculus, S. Chand, New Delhi
5. Utpal Chatterjee, Vector and Tensor Analysis , Academic Publishers ,Kolkatta
6. Dasgupta , Differential Calculus, Bharti Bhawan Patna

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MIC-02: Calculus & Geometry (03 credits) (Lecture: 30)

Course Objectives: The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real-world problems.

Course Learning Outcomes: This course will enable the students to:
i) Apply derivatives in Optimization, Social sciences, Physics and Life sciences etc.
ii) Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.

Course Contents:

Unit 1 **(Lectures: 08)**
Successive differentiation and Leibnitz's theorem, Maclaurin's and Taylor's series of Expansion, Partial differentiation and Euler's theorem, Total Differential, L'Hospital's rule, Tangent and Normal, Asymptotes, Curvature.

Unit 2 **(Lectures: 08)**
Evaluation of definite integrals, Reduction formulae, Length of plane curve and area bounded by plane curves, Volumes and Surface area of solid revolution.

Unit 3 **(Lectures: 07)**
Transformation of rectangular axes, General equations of Conic and its Reduction to the normal form, Equation of the tangent and normal at a point of the Conic.

Unit 4 **(Lectures: 07)**
Sphere, Cone, Cylinder, Central conicoid, Paraboloids, Plane section of conicoid, Generating lines, Tangent plane and normal to a conicoid.

References:

1. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Indian Reprint (2016) by Wiley India Pvt. Ltd. Delhi.
2. Osborne, George. A. (1906). *Differential and Integral Calculus with Examples and Applications*. Revised Edition. D. C. Health & Co. Publishers. Boston, U.S.A.
3. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.
4. SL.Loney , Coordinate Geometry
5. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). *Thomas' Calculus* (13th ed.). Pearson Education, Delhi. Indian Reprint 2017.

Additional Readings:

1. Lalji Prasad , Integral Calculus, Paramount Publications Patna
2. Shanti Narayan , P.K.Mittal , Integral Calculus, S. Chand, New Delhi
3. B.C. Das and B.N. Mukherjee, Differential calculus, Dhur& Sons Pvt.Ltd. Kolkatta

4. A skwith, The Analytical Geometry of the conic sections.
5. S L Loney ,Coordinate Geometry
6. Dasgupta, Differential calculus, Bharti Bhawan Patna

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4 Year Bachelor of Science/ Arts (MATHEMATICS) CBCS

List of Major Core Courses (MJC):

Sl. No.	Sem	Course Code	Name of the Course	Credits	Marks
1.	I	MJC-01	Algebra	6	100
2.	II	MJC-02	Calculus &Geometry	6	100
3.	III	MJC-03	Real Analysis	5	100
4.	III	MJC-04	Ordinary Differential Equations	4	100
5.	IV	MJC-05	Theory of Real Functions	5	100
6.	IV	MJC-06	Group Theory	5	100
7.	IV	MJC-07	Partial Differential Equations	5	100
8.	V	MJC-08	Ring Theory and Linear Algebra-I	5	100
9.	V	MJC-09	Multivariate Calculus	5	100
10.	VI	MJC-10	Complex Analysis	4	100
11.	VI	MJC-11	Metric Space	5	100
12.	VI	MJC-12	Riemann Integration and Series of Functions	5	100
13.	VII	MJC-13	Ring Theory and Linear Algebra-II	5	100
14.	VII	MJC-14	Research Methodology	5	100
15.	VII	MJC-15	Numerical Methods	6	100
16.	VIII	MJC-16	Mathematical Finance	4	100
Sub Total = 80					

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4 Year Bachelor of Science/ Arts (MATHEMATICS) CBCS

List of Minor Core Courses (MIC):

Sl. No.	Sem.	Course Code	Name of the Course	Credits	Marks
1.	I	MIC-01	Algebra	3	100
2.	II	MIC-02	Calculus &Geometry	3	100
3.	III	MIC-03	Real Analysis	3	100
4.	IV	MIC-04	Ordinary Differential Equations	3	100
5.	V	MIC-05	Theory of Real Functions	3	100
6.	V	MIC-06	Group Theory	3	100
7.	VI	MIC-07	Partial Differential Equations	3	100
8.	VI	MIC-08	Ring Theory and Linear Algebra-I	3	100
9.	VII	MIC-09	Multivariate Calculus	4	100
10.	VIII	MIC-10	Complex Analysis	4	100
Sub Total = 32					